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BANANA PEEL WASTES: POTENTIAL SOURCE OF ANTIOXIDANT IN BANANA CHIPS

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ABSTRACT

Banana are one of the most popular fruit carries a number of beneficial pharmacological effects and comes with a set of variety and it is distributed all over the world. The major by-product of the banana processing industry is the peel causing environmental hazard. High dietary fibre, polyphenolic and related bioactive compounds content of banana peels make them promising for variety of applications in nutraceuticals and medicinal purposes.

In the present study the banana chips with and without peel were prepared by drying (using tray dryer at 60^0C 70^0C, 80^0C) and microwave processing (360, 540, 720, 900 watt). The results showed that moisture loss and shrinkage loss of banana chips increased with increase in time of drying and temperature and wattage of microwave. All types of chips were accepted by sensory analysis with highest gradation was obtained by microwave processed chips without frying. Polyphenol content (mg GAE/gm) of tray dried and microwave dried banana chips with and without peel were investigated which showed that microwave processed banana chips with peel contain highest amount of polyphenols compared to other varieties. Hence consumption of microwave processed banana chips with peel may be useful to combat free radical mediated diseases.

KEYWORDS: Banana Chips, Peel, Polyphenol, Microwave, Sensory Analysis & Tray Drier

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Original Article

INTRODUCTION

In ancient Indian literature the medicinal properties of banana have been documented and found to be effective in cure of many diseases [1]. As a staple fruit, it is available through-out the year which provides livelihood security to thousands of people [2]. In banana processing industry the major waste is the peel, accounting 30% of the fruit which constitute environmental hazard [3]. According to the criteria established by the National Cancer Standard Institute, banana peel extract is classified as non-toxic to normal human cells [4]; therefore, it can be safely utilized as a natural source of antioxidants for value addition. It grows in humid low land to upland tropical areas [5]. Being as a tropical plant, banana protects itself from the oxidative stress caused by strong sunshine and high temperature by producing large amounts of antioxidants [6].

The peel and pulp of fully ripe banana provides good antimicrobial and antibiotic properties [7]. Banana peel is also an underutilized source of phenolic compounds. It accounts 40% of the total weight of fresh banana and these are used as fertilizer or discarded in many countries [8]. It contains various antioxidant compounds such as gallocatectin and dopamine and it is also the rich source of total phenolics and this in turn reflects their

antioxidant activity. Several flavonoids have been reported such as gallocatechin, catechin and epicatechin, of these, gallocatechin exhibited the greatest antioxidant activity and was found to be much higher in banana peel [4].

The objective was to make banana chips with its peels as peels carries lots of essential nutrients. Though raw banana has many health benefits but due to its unfavourable taste it's not accepted by the people as their daily diet, so by converting the raw banana into tasty crispy chips form we can easily provide it to them as a tasty nutritious food. The present study deals with the following aspects: a) preparation of microwave (360, 540, 720, 900 watt) dried banana chips (without oil), b) preparation of tray dried (50, 60, 70, 80, 90^{o}C) banana chips (with oil and spices), c) polyphenol content of microwave dried and tray dried banana chips, d) sensory analysis of all types of banana chips.

MATERIALS AND METHODS

Sample Preparation: Bananas were procured from local market of Sodepur, Kolkata; the selections of banana were unripe so as to get the best results. Each green raw banana samples weighed ranged from 47- 55gm. Then the samples (Whole banana) were peeled with the help of peeler and some were kept as a whole (with peels) and both the samples were cut to 3mm thickness.

Pre-Treatment: Sliced samples were pre-treated in different blanching agents by direct immersion in each 1% citric acid, KMS, salt, ascorbic acid, turmeric and mixture of citric acid and ascorbic acids solution at room temperature for 10 min to avoid loss of product firmness, to prevent enzymatic browning and for better color retention.

Drying: After pre-treatment, samples with peels and without peels were dried in two different ways i.e one dried in microwave with different wattages and other was tray dried at different temperature. The tray dried products were then divided into 6 groups. In the first groups, all the samples were uniformly spread in a stainless steel plate and kept in tray drier for 2-3 hrs until its moisture content became constant. In the 2nd, 3th, 4th, 5th and 6th groups all the samples were uniformly spread in a stainless steel plate and dried at 50,60,70,80,90 °C respectively for 20 min in the tray drier (semi dried at 50,60,70,80,90 °C). In the microwave drying four samples were considered, the four samples were spread in microwave bowl and kept in microwave at 360, 540, 720, 900 watt respectively for 6 mins.

Frying: Frying was done for tray dried products only, as the microwave products can be taken without frying. Palm olein was used for deep frying for the preparation of crunchy banana chips. First the oil is heated and then the sliced banana were fried until the color changes to little yellowish brown and it's became crispy as shown in the figure. After frying the chips are taken out and kept on blotting paper for the absorption of the extra surface adhesion oil.

Spicing and Packaging: Then spices like salt, cumin power, chilli power were added in both microwave dried products and tray dried products. Then the prepared banana chips were packed in LDPE (low density polyethylene) bags and stored.

Flow Chart of Banana Chips Preparation

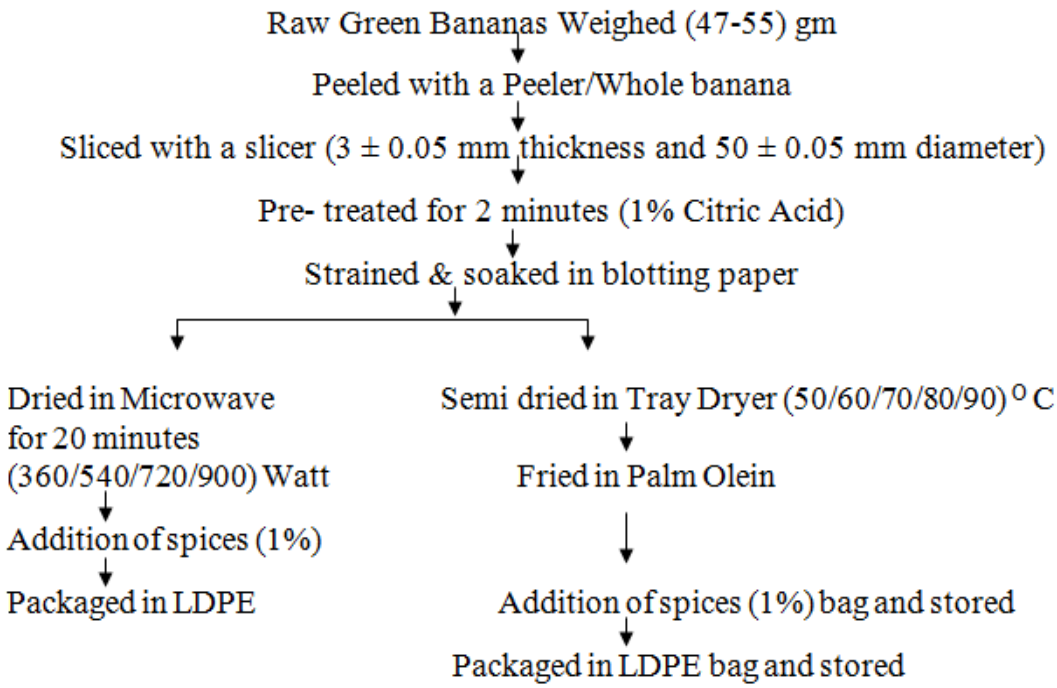

Figure 1

METHODOLOGY

All the samples were analyzed for moisture content by AOAC, 2000 [9]. Then drying curve and drying rate curve was plotted on the basis of moisture content of samples with variable time and temperature/ wattage. The total phenols of all sample extracts were measured at 765 nm by Folin Ciocalteu reagent [10]. A 9 point hedonic scale (1= lowest desirability, 9= highest desirability) was used to evaluate the sensory characteristics by using ten trained panelists [11]. All the data were normally distributed and expressed as Mean ± SD [12].

RESULTS AND DISCUSSIONS

Drying Time

In hot air drying with increasing temperature drying time decreases. Here the samples that were dried in tray dryer at 50°C, 60°C,70°C, 80^{o} C, 90^{o} C the total time taken to reach the constant moisture content was 135min, 120min, 90min, 75min, 60min respectively (Figure 1). So, as the drying temperature increased from 50°C to 90°C for the 3 mm thick banana slices, there was approximately 55.6% savings in time. These results agreed with drying of apple pomace by Motevali *et al.* [13] and banana by Abano and Sam-Amoah [14].

In microwave drying with increasing temperature drying time decreases. Here the samples that were dried in microwave at 360W, 540W, 720W, 900W the total time taken to reach the constant moisture content was 9min, 7min, 5min,5min, respectively (Figure 1). These results showed that drying time of samples to reach the constant moisture content requires minimum of 60 min in tray drying method which can be decreased to 5 min in microwave drying method. So, 91.67% reduction in drying time is observed for microwave drying which satisfied the observation of Tavakolipour and Zirjani [15].

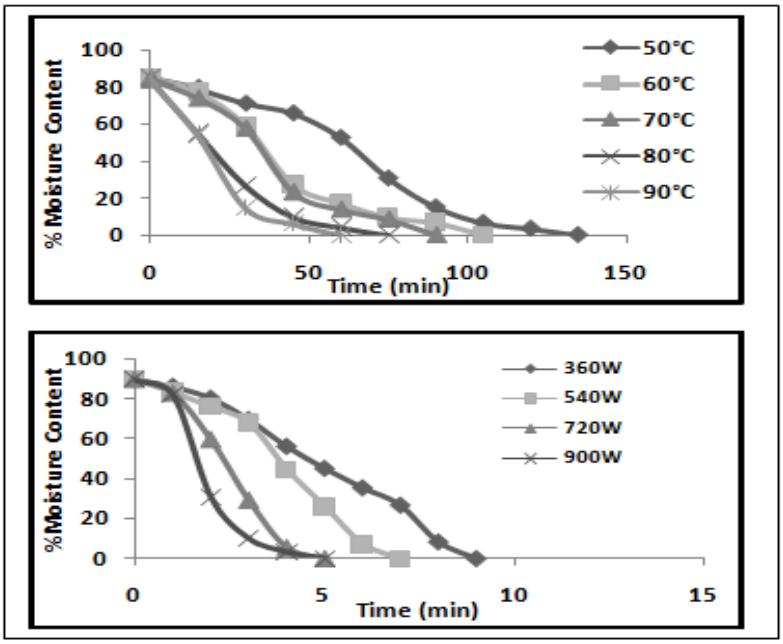

Figure 2: Comparison of Moisture Content with Time for Different Temperatures (Drying Curve) using Tray Drying and Microwave Drying

Drying Rate Curve

The drying rate was calculated by dividing difference of two consecutive moisture contents by time interval and plotted against moisture content based on wet basis.

The drying rate was calculated by dividing difference of two consecutive moisture contents by time intervals and plotted against moisture content based on dry basis. Results of tray drying experiments showed that with increasing of temperature increased drying rate and at microwave drying method with increasing of microwave power intensity increased drying rate (Figure 2 &3). Comparison of drying rate at both drying methods showed that average drying rate during tray drying was about 0.043 (kgw/kgdm.hr) and in microwave drying was 0.13 ((kgw/kgdm.hr) that threefold of tray drying rate. These results agreed with drying rate of banana chips by Tavakolipour and Zirjani [15].

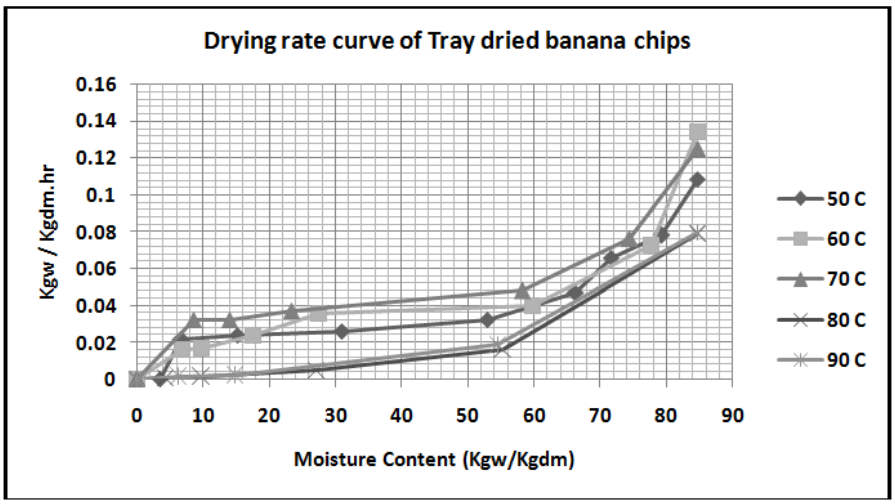

Figure 3: Comparison of Drying Rate with Moisture Content for Different Temperatures using Tray Drying (Drying Rate Curve)

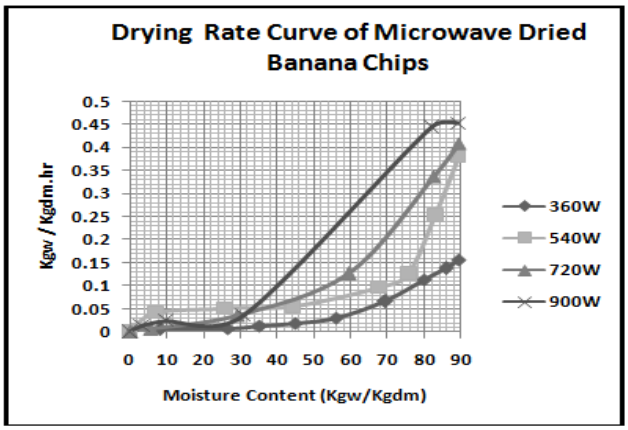

Figure 4: Comparison of Drying Rate with Moisture Content for Different Temperatures using Microwave Drying (Drying Rate Curve)

Shrinkage Loss

The raw peeled banana slices were blanched and taken under several blanching agents and temperature as well. The blanching agents that used are 1) 1% turmeric, 2) 1% KMS, 3) 1% Salt, 4) 1% Citric acid, 5) 1% ascorbic acid, 6) 1% (citric + ascorbic acid) (1:1). The overall shrinkage loss was measured by measuring their thickness and diameter by using vernier scale and screw gauge.

The shrinkage percentage is a drying quality assessing parameter that directly affects the rehydration quality of the dried product. The shrinkage percentage was calculated by determining the size of the banana slices, before and after drying. In case of tray drying the minimum shrinkage percentages of 7.7 (50°C), 10.26 (60°C), 14.82 (70°C), 17.63 (80^{o} C) and 18.88 (90^{o} C) were observed with the blanching treatment of citric acid except at 50°C where it is turmeric at thickness of 3 mm (Figure 4).

For microwave treatment the minimum shrinkage percentages of 12.8 (360W), 20.75 (540W), 26.85 (720W) and 35.89 (900W) were observed with the blanching treatment of turmeric, KMS, salt and KMS respectively at thickness of 3 mm (Figure 4). The Effect of Drying Kinetic on Shrinkage and Colour of Potato Slices in the Vacuum- Infrared Drying Method were also observed by Hafezi *et al.* [16] and Faisal *et al*. [17].

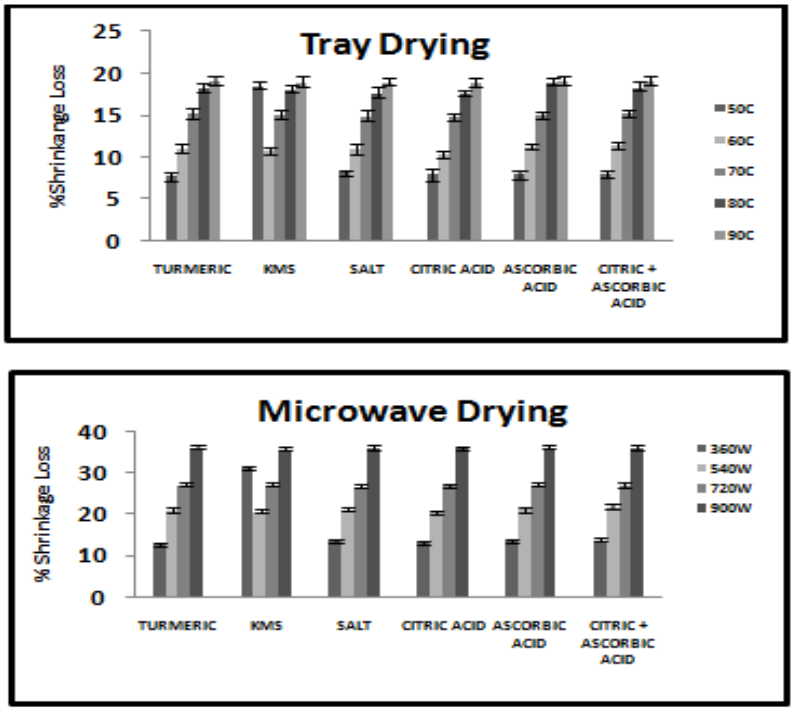

Figure 5: Comparison of Shrinkage Loss with Different Blanching Agents for Different Temperature using Tray Drying and Microwave Drying

Polyphenol Content

The polyphenol content of all the samples were shown in Figure 5. The polyphenol content of raw samples (raw banana pulp, raw banana peel, raw banana slice with peel) were found to be 29.8, 19.7, 35.4 mg GAE/g (dry wt basis) respectively. The methanolic extract of banana, apple, red beet, potato peels were also observed by Abd el-Baky and Ahmed, 2010 [18] which also satisfied the above mentioned values. The effect of heat treatment on polyphenol content were found to be 5.83, 6.4, 11.6 mg GAE/g (dry wt basis) in tray dried samples (70^0C) and 6.12, 8.97, 12.6 mg GAE/g (dry wt basis) in microwave treated samples (540 Watt) respectively, which showed higher polyphenol retention with microwave treatment.

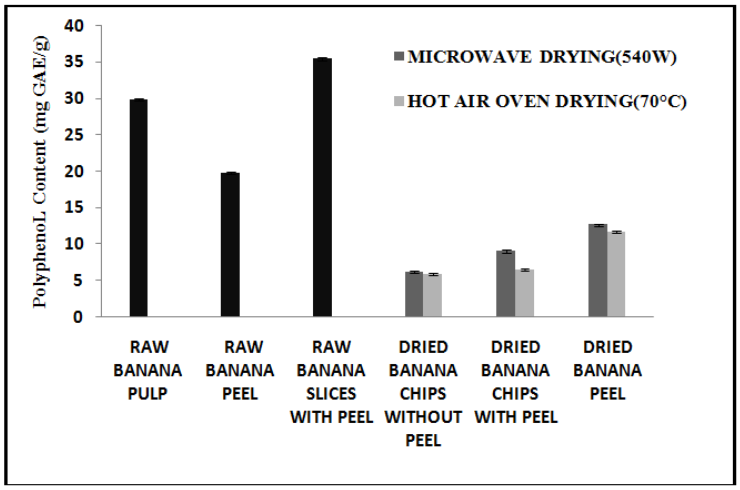

Figure 6: Comparison of Polyphenol Content of Different Types of Raw,Tray Dried and Microwave Treated Samples

Effect of Drying on Overall Acceptability

Sensory evaluation of the processed banana chips were measured and their overall acceptability were assessed (Figure 6). Tray dried at 70°C followed by oil fried banana chips showed maximum overall acceptability which was comparable with the market sample. Further, increase of temperature in tray drying caused darkening of the product with decreased overall acceptability which also supports the findings of Faisal *et al*. [17]. Whereas in case of microwave treated oil free banana chips the maximum overall acceptability was found to be at 540 W for 6 minutes treatment with optimum shrinkage loss. The Effect of drying kinetics on overall acceptability of potato cubes were also observed by Faisal *et al*. [17].

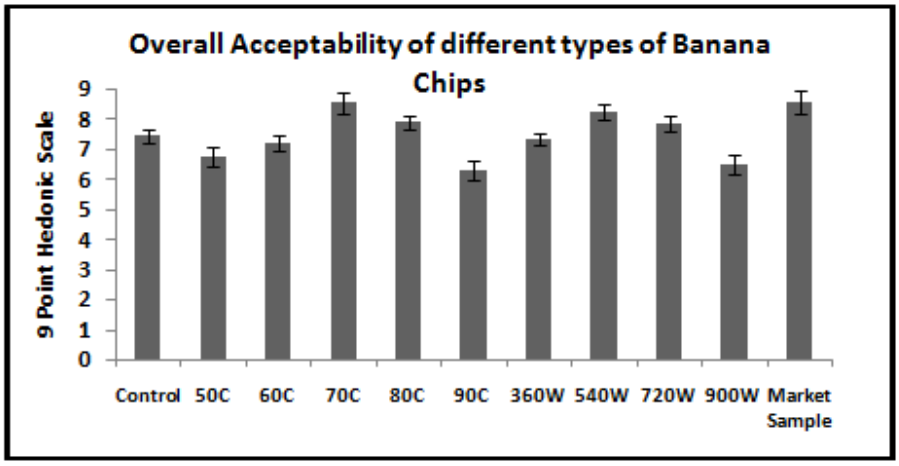

Figure 7: Comparison of Sensory Analysis of Different Types of Tray Dried and Microwave Treated Samples

CONCLUSIONS

It can be concluded that microwave processed banana chips with peel provide more nutraceutical application and antioxidant potential compared with conventional tray dried followed by oil fried chips.

Therefore, it is high time to investigate the unexplored area for value addition of banana peel and to devote more efforts towards the use of bioactive constituents which are present in them.

ACKNOWLEDGEMENTS

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